



PATENT

Case Docket No. MICRON.8DV2C1

Date: January 5, 2005

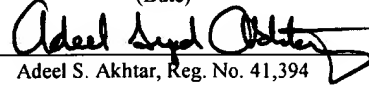
Page 1

In re application of : Schuegraf  
Appl. No. : 09/770,540  
Filed : January 26, 2001  
For : RUGGED METAL  
ELECTRODES FOR  
METAL-INSULATOR-  
METAL CAPACITORS  
Examiner : Laura M. Schillinger  
Art Unit : 2813

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January 5, 2005

(Date)

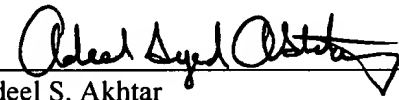
  
Adeel S. Akhtar, Reg. No. 41,394

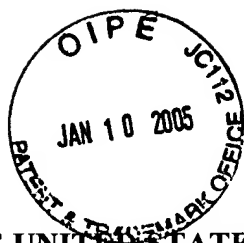
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Sir:

Transmitted herewith in triplicate is Replacement Appeal Brief to the Board of Patent Appeals:

- (X) Appendix A presents the claims on appeal.
- (X) Appendix B presents a copy of a Notification of Non-Compliance with respect to the prior Appeal Brief.
- (X) The fee for the Appeal Brief under 37 CFR §1.17(c) was paid with the prior Appeal Brief on September 21, 2004.
- (X) If applicant has not requested a sufficient extension of time and/or has not paid any other fee in a sufficient amount to prevent the abandonment of this application, please consider this as a Request for an Extension for the required time period and/or authorization to charge our Deposit Account No. 11-1410 for any fee which may be due. Please credit any overpayment to Deposit Account No. 11-1410.
- (X) Return prepaid postcard.

  
Adeel S. Akhtar  
Registration No. 41,394  
Attorney of Record  
Customer No. 20,995  
(415) 954-4114

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

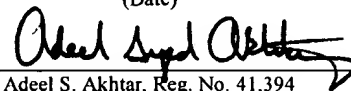
Applicant : Schuegraf  
Appl. No. : 09/770,540  
Filed : January 26, 2001  
For : RUGGED METAL ELECTRODES  
FOR METAL-INSULATOR-  
METAL CAPACITORS  
Examiner : Laura M. Schillinger  
Group Art Unit : 2813

**CERTIFICATE OF MAILING**

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January 5, 2005

(Date)

  
Adeel S. Akhtar, Reg. No. 41,394

**ON APPEAL TO THE BOARD OF PATENT APPEALS AND INTERFERENCES**  
**REPLACEMENT APPEAL BRIEF**

Mail Stop Appeal Brief -- Patents  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

This Appeal Brief relates to an appeal to the Board of Patent Appeals and Interferences of the final rejection set forth in a final Office Action mailed March 24, 2004 in the above-captioned application and is responsive to the Notification of Non-Compliance with 37 C.F.R. § 1.192(c) mailed December 8, 2004 (attached hereto as Appendix B).

**I. REAL PARTY IN INTEREST**

The real party in interest in this appeal is the assignee of this application, Micron Technology, Inc.

**II. RELATED APPEALS AND INTERFERENCES**

Appellant is unaware of any related appeals or interferences.

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**Filed** : **January 26, 2001**

### **III. STATUS OF THE CLAIMS**

The application was originally filed with Claims 1-20. By Preliminary Amendment, Claims 13-19 were cancelled and Claims 21-24 added. Claims 1-5 were restricted from prosecution and withdrawn, but have never been cancelled during the course of prosecution.

Through subsequent prosecution, after an indication of allowance of Claims 6-12, Appellant cancelled Claims 20-24. However, allowability of Claims 6-12 was subsequently withdrawn in view of a new reference, such that Appellant attempted to reintroduce the cancelled claims in the form of new Claims 25-30. While that Amendment was entered by the Examiner, the Examiner withdrew from consideration Claims 25-28, despite the fact that they were substantially identical (albeit somewhat narrowed) to originally examined Claims 20-24.

Thus, by Final Office Action of March 24, 2004, the Examiner finally rejected Claims 6-12 and 29-30, while Claims 1-5 and 25-28 were withdrawn from consideration.

In summary, Claims 13-24 are cancelled, Claims 1-5 and 25-28 are withdrawn, and Claims 6-12 and 29-30 are rejected. Claims 6-12 and 29-30 are before the Board as finally rejected. The claims that are the subject of the present appeal are reproduced and attached as Appendix A.

### **IV. STATUS OF AMENDMENTS**

All offered amendments have been entered. The claims appear before the Board as they were finally rejected (Claims 6-12 and 29-30) and are attached hereto as Appendix A.

### **V. SUMMARY OF CLAIMED SUBJECT MATTER**

As described in the Background of the Invention of the application as filed, one method of increasing the capacitance of capacitors used in memory cells, such as dynamic random access memory (DRAM), is to increase the surface area of memory cell plates, such as by utilizing electrodes having a textured surface morphology, and another method is to employ capacitor dielectric materials having higher dielectric constants. *See* Application at p. 1, ll. 27-30. However, due to their reactivity and complex processing, high dielectric constant materials are generally not compatible with traditional polysilicon electrodes, such that efforts have been

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directed towards developing suitable metal electrodes for use with high dielectrics. *See* Application at p. 2, ll. 9-12.

Independent Claim 6 recites a process by which a high surface area electrode can be produced in a metal form that can be resistant to high dielectric materials. The process includes first forming a textured silicon structure and subsequently replacing silicon atoms in the textured structure with metal atoms. Application at p. 3, ll. 6-9. In an illustrated embodiment, the electrode is first formed as an amorphous or polycrystalline structure that is annealed to form a silicon surface with a textured surface morphology. A metal substitution process exposes the textured silicon to a refractory metal-halide complex, such as  $WF_6$ , thus producing the rugged metal surface. Application at p. 3, ll. 9-14.

The detailed description and figures illustrate the preferred embodiment of the invention. Figure 1 illustrates a rugged silicon electrode 24 having a textured or rugged surface region 26. Application at p. 5, ll. 7-9. In an exemplary process for forming this rough or rugged surface 26 results in a morphology which is bulbous and includes relatively large polycrystallites, referred to as Hemispherically Grained Silicon (HSG). Application at p. 5, ll. 29-31. This rugged silicon surface 26 is subsequently converted to a rugged metal surface by a substitution reaction whereby a refractory metal-halide complex is exposed to the silicon surface under the appropriate conditions and metal atoms replace the silicon atoms in the rugged structure. *See* Application at p. 6, ll. 14-27.

The appealed claims reflect this inventive sequence. Specifically, independent Claim 6 recites forming a silicon electrode structure, making the silicon electrode structure rugged, and, *after making the silicon electrode rugged*, replacing the silicon in the rugged silicon electrode structure with a metal, thereby forming a rugged metal electrode.

## **VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL**

This Appeal turns on one issue:

- (1) Claims 6-12 and 29-30 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Sekine et al. (U.S. Patent No. 5,622,888).

## VII. APPELLANT'S ARGUMENT

### A. Claims 6-12 Are Patentable Over Sekine et al.

The Examiner has rejected Claims 6-12 as being anticipated under 35 U.S.C. § 102(e) by Sekine et al. (U.S. Patent No. 5,622,888).

Appellant traverses the rejection on the basis of the fact that the sole reference employed in the rejection fails to teach or suggest the *sequence* recited in independent Claim 6. It is well established that the Examiner cannot merely provide all of the elements of Appellant's claim in the prior art, but rather must show that the prior art teaches or suggests these elements *in the manner claimed*. "[R]ejecting patents solely by finding prior art corollaries for the claimed elements would permit an examiner to use the claimed invention itself as a blueprint for piecing together elements in the prior art to defeat the patentability of the claimed invention." In re Rouffet, 47 U.S.P.Q. 2d 1453, 1457 (Fed. Cir. 1998). In the present case, the Examiner employs Sekine's teaching of a substitution reaction (substituting silicon atoms for metal atoms), in which the substitution reaction itself forms the rugged surface, whereas Appellant has specifically recited a sequence in which the silicon is first made rugged and subsequently replaced by metal. Sekine simply does not teach this sequence.

The Examiner supports her rejections by stating that after making the silicon electrode rugged (pointing to element 73a in FIG. 3(b)), Sekine teaches replacing the silicon in the silicon structure with a metal to thereby form a textured metal electrode (pointing to element 73b of FIG. 3(b)). Additionally, the Examiner points to Sekine's teaching of the rugged structure silicon atoms comprising HSG (pointing to Col. 1, ll. 55-57 of Sekine).

Appellant submits that the Examiner bases the rejections upon an incorrect understanding of Sekine. Contrary to the Examiner's assertions, Sekine clearly teaches depositing "a phosphorous-doped amorphous polysilicon layer" which is subsequently "patterned into a lower capacitive electrode 2 by lithography/etching." Sekine at Col. 5, ll. 10-14. Sekine does not teach or suggest that the lower capacitive electrode 2 is rugged, nor is it shown as such in FIG. 3(a).

Following patterning of the polysilicon layer that forms the capacitive electrode 2, a substitution reaction is conducted, "thereby replacing a surface layer of the phosphorous-doped amorphous polysilicon with a *tungsten layer 73a* as shown in FIG. 3(b)." Col. 5, ll. 25-27. While the Examiner states that layer 73a represents a rugged silicon layer, the specification of

Sekine clearly indicates that 73a is a tungsten layer. The Examiner is *factually incorrect* about whether 73a represents a silicon layer or a tungsten layer. It is only with the formation of the tungsten layer that any rugged surface is ever introduced in the teachings of Sekine. In other words, the embodiments of Sekine's invention do not include any rugged silicon structure prior to the substitution reaction that forms the rugged metal layer, contrary to the recitation of independent Claim 6 that the substitution reaction follows the formation of a rugged silicon structure.

Furthermore, both of the layers 73a and 73b are tungsten layers, not silicon layers. After the substitution reaction first introduces a rugged surface by formation of a rugged tungsten surface 73a, an additional tungsten layer is then deposited by a non-replacement reaction "so that a tungsten layer 73b is deposited on the tungsten layer 73a as shown in FIG. 3(b)." Sekine at Col. 5, ll. 42-47.

In summary, Sekine teaches first forming a polysilicon electrode 2 and does not teach that this polysilicon electrode 2 is rugged; a replacement reaction is performed on this silicon layer to form a rugged surface tungsten layer 73a; and a subsequent tungsten layer 73b is deposited on top of this first tungsten layer 73a. Sekine neither teaches nor suggests that the initial silicon layer should be made rugged prior to forming the replacement reaction. In fact, it is the replacement reaction itself that produces a rugged surface; Sekine teaches that at the time of the replacement reaction:

the nuclear generation density of tungsten varies due to the partial pressure of  $WF_6$  and the concentration of impurities in the phosphorous doped amorphous polysilicon. Specifically, since the nuclear generation of tungsten decreases as the concentration of impurities in the polycrystalline silicon is lower and the partial pressure of  $WF_6$  as defined by the above formula is lower, crystalline particles of tungsten are produced in a minute coarse distribution.

Sekine at Col. 5, ll. 30-35.

Thus, it is only during the process of the substitution reaction that any rugged surface is defined. Thus, the Examiner has incorrectly identified tungsten layer 73a as a rugged silicon layer, and nowhere does the reference teach or suggest a sequence in which a rugged silicon structure is first formed, and a substitution reaction performed thereafter.

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The Examiner's erroneous finding that a rugged silicon structure pre-exists at the time of the substitution reaction is further underscored by the unwarranted and unmotivated combination with the Background teachings of Sekine, as discussed in more detail in the next argument section.

Accordingly, Appellant respectfully submits that Sekine does not teach or suggest each and every element of independent Claim 6 and therefore fails to anticipate it or render it obvious. Dependent Claims 7-12 each depend from independent Claim 6 and recite further distinguishing features of particular utility. Accordingly, Appellant respectfully submits that Claims 7-12 are also allowable over the art of record.

**B. Claims 29-30 Are Patentable Over Sekine et al.**

Initially, Appellant points out that Claims 29-30 depend from independent Claim 6. Therefore, these claims contain all the features and limitations of independent Claim 6 and the arguments above, based on the Examiner's factual misunderstanding of the process in Sekine, apply equally to Claims 29-30.

Furthermore, Claims 29-30 recite that the silicon rugged structure "comprises a hemispherically grained silicon structure." In finding these claims anticipated by Sekine, the Examiner states that Sekine teaches "the rugged structure of silicon atoms comprises HGS [Sic:HSG] (Col. 1, lines : 55-57)." Final Office Action at page 4.

Appellant submits that the Examiner points to the **Background** teachings of Sekine, and not the preferred embodiment of Sekine. Although the Examiner styles the rejection as one of anticipation, in fact the rejection represents an unmotivated combination of Background teachings and preferred embodiment teachings. Nowhere does Sekine teach or suggest combining the Background teachings of HSG silicon with the preferred embodiment wherein electrode is ruggedized by the substitution reaction itself.

In fact, Sekine clearly *teaches away* from the use of HSG silicon as undesirable. In particular, Sekine refers to a prior art process in which tungsten is *deposited* directly on HSG silicon, not a process in which a substitution reaction is used. Furthermore, Sekine teaches that this prior art process in which HSG silicon is formed and followed by metal deposition is undesirable because it results in flattening and therefore loss of the increased surface area:

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Recently there has been developed and put to use a technique to roughen a surface of such phosphorous-doped polysilicon by way of HSG until the surface thereof is almost doubled.

If, however, a tungsten film is deposited to a thickness of at least 100 nm on the roughened surface of the phosphorous-doped polysilicon, the roughened surface of the phosphorous-doped polysilicon will be flattened, eliminating the increase of the surface area thereof . . . Therefore the surface of the phosphorous-doped polysilicon is no longer rough, but made flat and smooth, and, as a result, does not have the increased surface area.

Sekine at Col. 1, l. 34 to Col. 2, l. 3.

Therefore, the Examiner has short-circuited the requirement to show a motivation to combine the two separate teachings of Sekine by presenting the rejection as one of anticipation. If properly dealt with as an obviousness rejection, it is clear that the combination is unfair. The Examiner attempts to combine the Background teachings of Sekine (HSG, which Sekine itself teaches away from), with the preferred embodiment of Sekine, in which no HSG silicon formation is taught or suggested.

Accordingly, Appellant submits that dependent Claims 29 and 30 are patentable over Sekine because Sekine does not teach or suggest the recited sequence of first forming a rugged silicon surface and subsequently performing a substitution reaction, as pointed out in argument section A., above, and for the additional reason that there is no teaching or suggestion within Sekine to employ the substitution reaction in combination with the use of HSG silicon.

### **C. Conclusion**

In view of the foregoing arguments, Appellant respectfully submits that Claims 6-12 and 29-30 are patentable over Sekine et al.

## **VIII. APPENDIX A**

Attached hereto as Appendix A is a copy of the finally rejected claims in the present case.

## **IX. APPENDIX B**

Attached hereto as Appendix B is a copy of the Notification of Non-Compliance With 37 C.F.R. § 1.192(c)



**Appl. No.** : **09/770,540**  
**Filed** : **January 26, 2001**

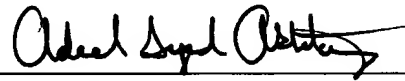
Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: January 5, 2005

By:



Adeel S. Akhtar  
Registration No. 41,394  
Attorney of Record  
Customer No. 20,995  
(415) 954-4114

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**APPENDIX A**  
(Claims as finally rejected)

1. – 5. (Withdrawn)
6. (Previously Presented) A process for fabricating a metal-insulator-metal capacitor on a semiconductor wafer comprising the steps of:
  - forming a silicon electrode structure on the semiconductor wafer;
  - making the silicon electrode structure rugged; and
  - after making the silicon electrode rugged, replacing the silicon in the rugged silicon electrode structure with a metal, thereby forming a rugged metal electrode.
7. (Previously Presented) The process of Claim 6, further comprising covering the rugged metal electrode with a dielectric layer having a high dielectric constant.
8. (Original) The process of Claim 7, further comprising covering the dielectric layer with a metal layer.
9. (Previously Presented) The process of Claim 6, wherein the step of replacing the silicon in the silicon electrode structure comprises forming a boundary layer on the silicon electrode structure, exposing the silicon electrode structure to a refractory metal-halide complex, and removing the boundary layer.
10. (Previously Presented) The process of Claim 9, wherein the boundary layer comprises a dielectric and the refractory metal-halide complex comprises  $WF_6$ .
11. (Original) The process of Claim 7, wherein the dielectric layer comprises a material selected from the group consisting of  $Ta_2O_5$ ,  $BaTiO_3$ ,  $SrTiO_3$ ,  $Ba_xSr_{1-x}TiO_3$ , and  $PbZr_xTi_{1-x}O_3$ .
12. (Original) The process of Claim 8, wherein the metal layer comprises titanium.
- 13.-24. (Cancelled)
- 25.-28. (Withdrawn)
29. (Previously Presented) The process of Claim 6, wherein making the silicon electrode structure rugged comprises seeding and annealing to form a hemispherically grained silicon layer.
30. (Previously Presented) The process of Claim 6, wherein the rugged silicon electrode structure comprises a hemispherical grain morphology.



## APPENDIX B

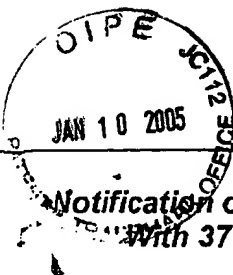
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/770,540	01/26/2001	Klaus F. Schuegraf	MICRON. 8DV2C1	6787
20995	7590	12/08/2004	EXAMINER	
KNOBBE MARTENS OLSON & BEAR LLP 2040 MAIN STREET FOURTEENTH FLOOR IRVINE, CA 92614			ART UNIT	PAPER NUMBER

DATE MAILED: 12/08/2004

Please find below and/or attached an Office communication concerning this application or proceeding.



**Notification of Non-Compliance  
With 37 CFR 1.192(c)**

Application No.

09/770,540

Applicant(s)

SCHUEGARAF, KLAUS F.

Examiner

Laura M Schillinger

Art Unit

2813

**--The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

The Appeal Brief filed on 24 September 2004 is defective for failure to comply with one or more provisions of 37 CFR 1.192(c). See MPEP § 1206.

To avoid dismissal of the appeal, applicant must file IN TRIPLICATE a complete new brief in compliance with 37 CFR 1.192(c) within the longest of any of the following three **TIME PERIODS**: (1) **ONE MONTH or THIRTY DAYS** from the mailing date of this Notification, whichever is longer; (2) **TWO MONTHS** from the date of the notice of appeal; or (3) within the period for reply to the action from which this appeal was taken. **EXTENSIONS OF THESE TIME PERIODS MAY BE GRANTED UNDER 37 CFR 1.136.**

1. ☐ The brief does not contain the items required under 37 CFR 1.192(c), or the items are not under the proper heading or in the proper order.
2. ☐ The brief does not contain a statement of the status of all claims, pending or cancelled, or does not identify the appealed claims (37 CFR 1.192(c)(3)).
3. ☐ At least one amendment has been filed subsequent to the final rejection, and the brief does not contain a statement of the status of each such amendment (37 CFR 1.192(c)(4)).
4. ☐ The brief does not contain a concise explanation of the claimed invention, referring to the specification by page and line number and to the drawing, if any, by reference characters (37 CFR 1.192(c)(5)).
5. ☐ The brief does not contain a concise statement of the issues presented for review (37 CFR 1.192(c)(6)).
6. ☐ A single ground of rejection has been applied to two or more claims in this application, and
  - (a) ☐ the brief omits the statement required by 37 CFR 1.192(c)(7) that one or more claims do not stand or fall together, yet presents arguments in support thereof in the argument section of the brief.
  - (b) ☐ the brief includes the statement required by 37 CFR 1.192(c)(7) that one or more claims do not stand or fall together, yet does not present arguments in support thereof in the argument section of the brief.
7. ☐ The brief does not present an argument under a separate heading for each issue on appeal (37 CFR 1.192(c)(8)).
8. ☐ The brief does not contain a correct copy of the appealed claims as an appendix thereto (37 CFR 1.192(c)(9)).
9. ☒ Other (including any explanation in support of the above items):

The status of the claims is not ripe for appeal because Applicant must petition the Examiner's restriction of claims 25-27; restriction requirements are not appealable